

Shared SPectrum Access for Radar and Communications (SSPARC) COMMDAR Project Overview

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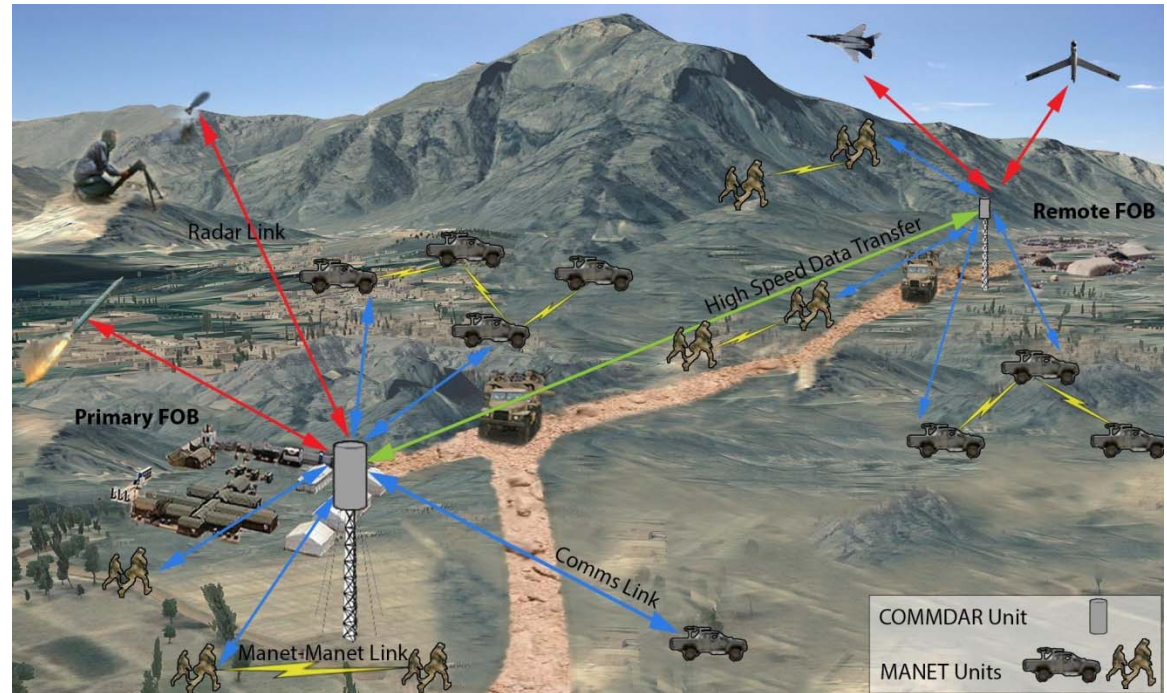
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COMMDAR Mission: FOB Protection

- Forward Operating Bases (FOBs) have low power radars and MANETs working in the same vicinity.
- COMMDAR combines radar and MANET base station functionality.
- Mission consists of several radar and communications functions:



Communications Functions:

1. Base station operation. Operating like a cellular base station to extend the MANET's range.
2. COMMDAR to MANET high data rate comms. Relaying information among commanders and the deployed forces, e.g. live video feeds from a UAV.
3. COMMDAR to COMMDAR high data rate comms. Relaying information between 'nearby' FOBs.

Radar Functions:

1. Counter rocket, artillery and mortar (CRAM). Warning of incoming rounds and point of origin information for counter-fire.
2. Air Surveillance. Detecting and tracking aircraft, manned and unmanned, especially low-flyers not picked up by regional air-surveillance systems.
3. Ground surveillance. Monitoring nearby traffic.

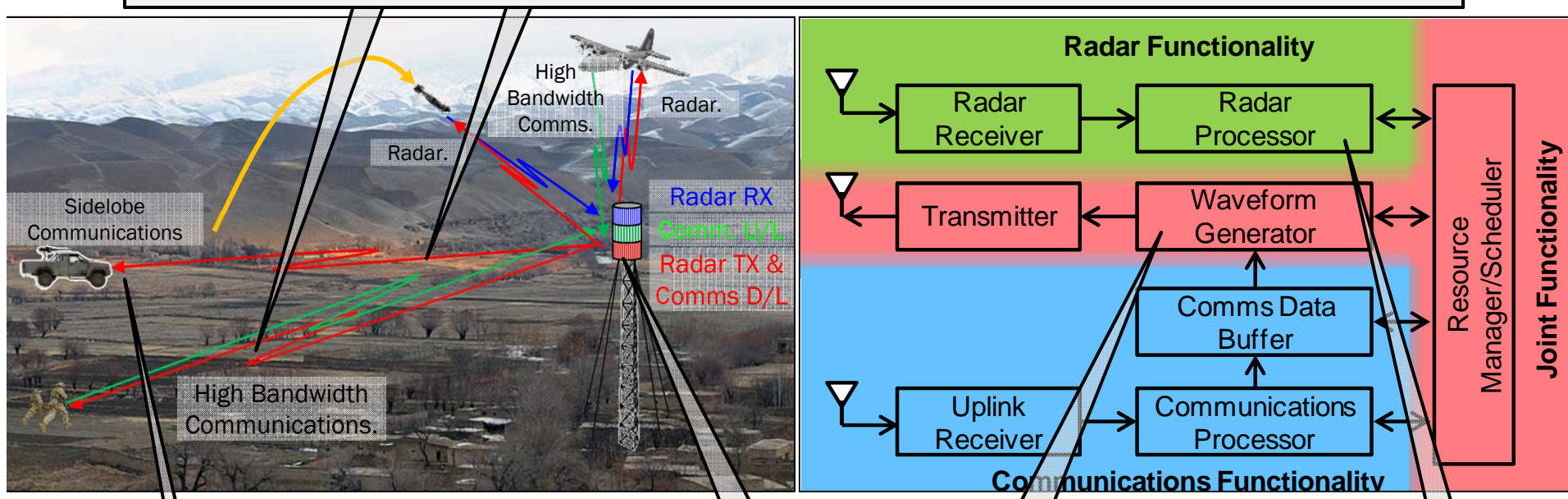
COMMDAR Reuses The Same Spectrum For All The Mission's Functions



COMMDAR System Description

COMMDAR: A synergistic system combining radar and cellular/land-mobile base station techniques so that the communications downlink and radar waveform are completely integrated, providing 100% spectrum access to both.

MIMO COMMDAR: The intersection of MIMO communications and MIMO radar enables the COMMDAR system to communicate with more radios while simultaneously searching for targets.



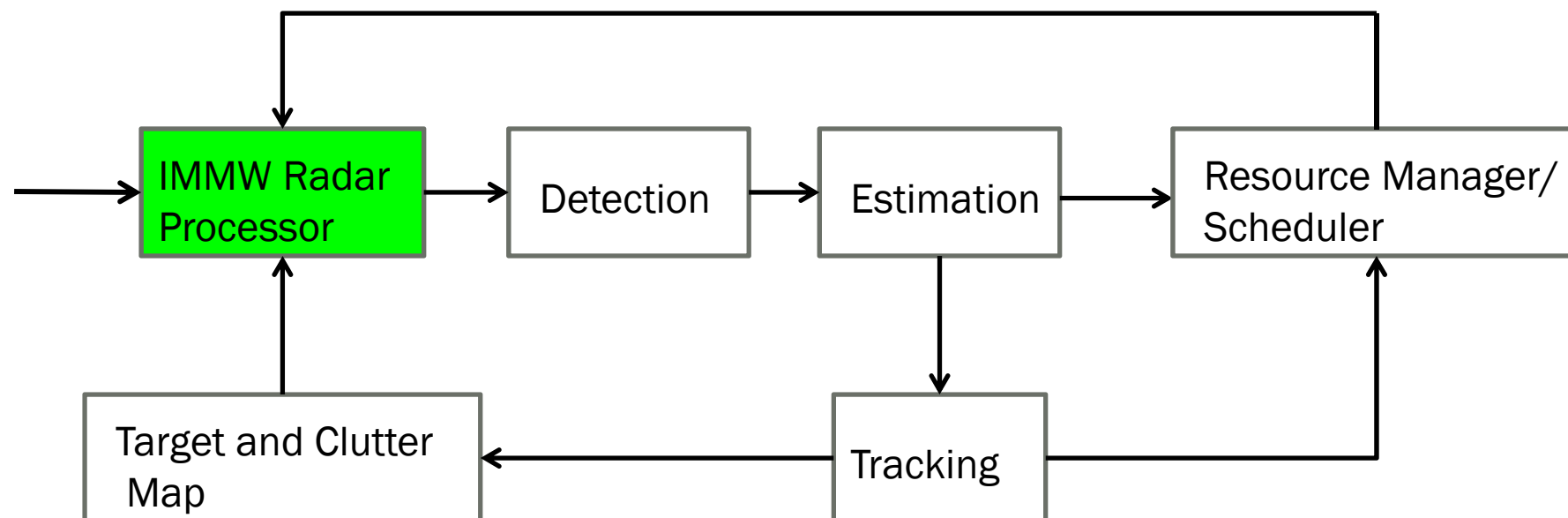
Sidelobe Communications: Making maximum of time the COMMDAR is not pointing at MANET radios to ensure that QoS requirements are met.

Integrated Multi-Mode Waveform (IMMW): Jointly optimized waveform for high data rate communications and radar whose (practically) unambiguous nature resulting in improved radar performance.

IMMW Radar Processor: Adaptive pulse-compression and Doppler processing techniques that ensure large targets and strong clutter do not degrade radar performance.



Radar Processor

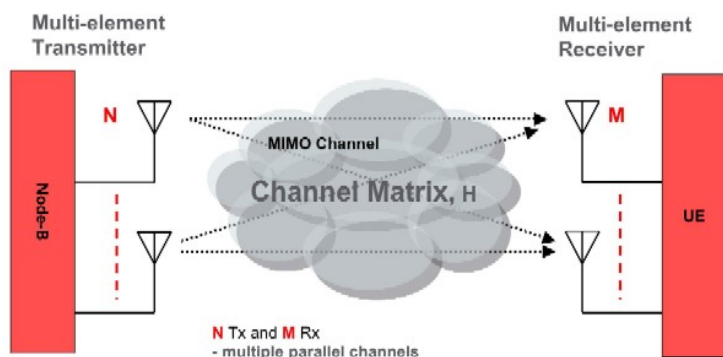


- Most radar functions are the same as a conventional radar
 - Detection, estimation, tracking
- IMMW Radar Processor contains COMMDAR unique filtering
 - Pulse compression, Doppler processing, clutter suppression
 - Computational complexity much higher than current radar systems, but still feasible in the latest FPGAs

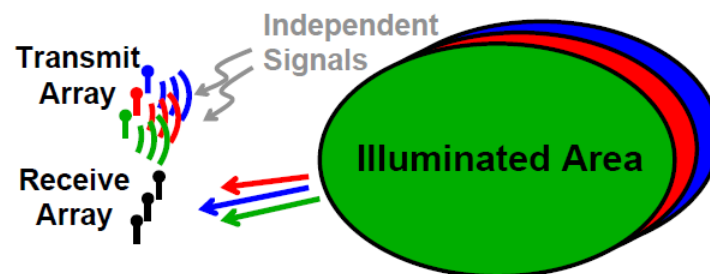


MIMO COMMDAR

MIMO Communications



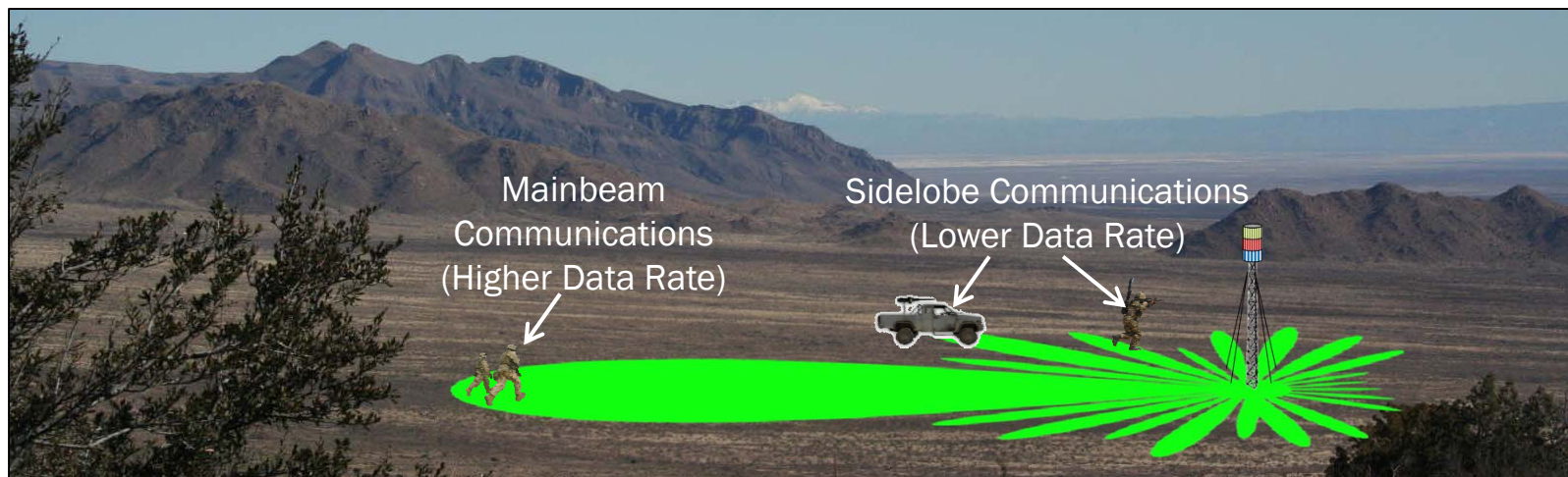
MIMO Radar



- MIMO Communications
 - Higher data rates in multipath scenarios by exploiting multiple spatial channels
- MIMO Radar
 - Same sensitivity and search rate as non-MIMO radar for search
 - Narrower effective receive beamwidth
- MIMO COMMDAR
 - Retains individual benefits of MIMO Radar and MIMO Communications
 - Synergistic benefit of higher average data rates
 - Wider transmit beam means each radio is illuminated for longer by the COMMDAR



Sidelobe Communications



- In most scenarios it is likely that COMMDAR will spend much of the time pointing away from the MANET users.
- Communicating through the transmit sidelobes (at lower data rates) enables low latency and better QoS for many low-data rate applications such as voice, text and network control.
- Each bit of information may be spread over multiple modulation symbols (like CDMA / DSSS) to make up for the lost antenna gain.
- Ensures 100% spectral reuse, though the data rate is low at times.



COMMDAR Challenges

- Radar Performance
 - Radar sensitivity
 - Suppression of clutter and strong targets
- Communications Performance
 - Data rate
 - Quality of Service
 - Network control
- High spectral re-use for both radar and communications
- Common MIMO waveforms for communications & radar
- Computational Complexity



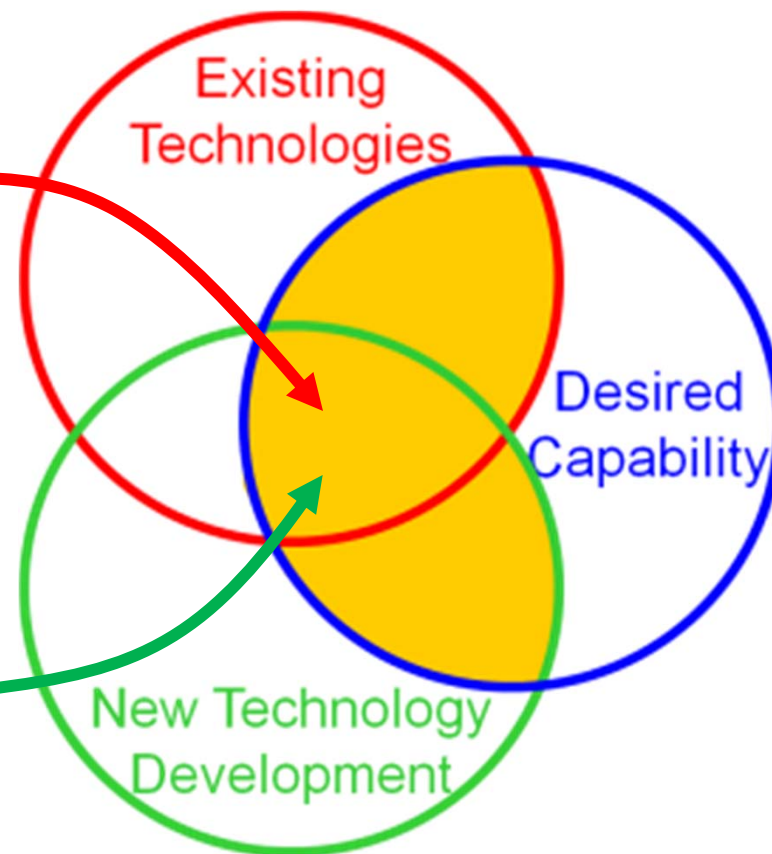
Leveraged and New Technologies

Existing Technologies Leveraged

- MIMO Radar.
- MIMO Communications.
- Statistic MIMO / Cooperative Radar.
- Ambiguity suppressing pulse compression (Passive Coherent Location).
- Radar resource management.
- Cellular resource management.
- Adaptive range-Doppler sidelobe suppression.
- LPD/LPI communications.
- Many existing radar, communications and EW sub-systems in common use

New Technologies Being Developed

Jointly optimized comms. and radar waveform IMMW radar processor.
Jointly optimized MIMO comms. and MIMO radar.
Sidelobe Communications
Jointly optimized resource management



COMMDAR is a new technology that blends existing and new component technologies